

**Information Systems Development Support (ISDS) Contract
Contract Work Order (CWO) Implementation Plan**

for

CWO 16 - Enhancement & Maintenance of Metric Prediction Software

Developed by
The ISDS Team
320 North Halstead, Suite 160
Pasadena CA 91107

Under

Contract No. 960100
Control Number: WIP_16 -1.DOC Rev 1
0
DRD # MA005
3 August~~10 January~~ 1995

for the

California Institute of Technology
Jet Propulsion Laboratory
4800 Oak Grove Drive
Pasadena CA 91109-8099

R. Kent Thomson
ISDS Program Manager

Mr. Don Lord
Program Manager

Jerry Hill
Contract Work Order Manager

Foreword

This is the top-level CWO document used for defining and controlling the effort, organizational structure, management authority and responsibility, and resource allocations for the CWO. This is the baseline continued enhancement and maintenance of the Metric Prediction Software CWO technical and management document developed under the guidelines set forth in DRD MA005 and in the ISDS Program Management Plan and supported by the ISDS methodology.

The **order of precedence** is the ISDS contract and attachments, then the ISDS Project Management Plan and its supporting procedures, and then this plan. The ISDS Project Management Plan and supporting procedures can be explicitly waived with the concurrence of JPL and ISDS team management. Such actions and decisions are documented in Section 11, Deviations, Exceptions, and Waivers.

Table of Contents

1. INTRODUCTION 111

2. SOW & DELIVERABLES 211

3. SOFTWARE DEVELOPMENT PLAN..... 333

4. MANAGEMENT APPROACH..... 322

5. RISK MANAGEMENT PLAN..... 433

6. WORK BREAKDOWN STRUCTURE (WBS) 433

7. CWO ORGANIZATION AND STAFFING 444

8. CWO SCHEDULE AND DEPENDENCIES..... 655

9. GFE/GFI ITEMS..... 755

10. CLOSE-OUT PLAN..... 765

11. DEVIATIONS, WAIVERS, & EXCEPTIONS..... 765

12. APPENDICES..... 765

1. Introduction

Metric Prediction represents a software component of the Network Support Controller (NSC), Network Support Subsystem (NSS). The overall requirements for NSS, of which this CWO is a part are: 1) Expand Planetary ephemeris sources to include NAVIO formats, 2) Enhance DSN user access to schedule information, 3) Provide the capability of providing ephemeris on multiple central bodies without significant loss of prediction accuracy, 4) Provide support for Galileo low-gain antenna mission, 5) Provide cable wrap information in antenna pointing predictions, 6) Provide processing, generation and transmittal of support data to the Telemetry Simulation Assembly (CWO 3). This CWO is directly involved in all of these requirements with the exception of 2, Schedule, and 3, Multiple Central Bodies, as defined above.

1.1 Background

Metric Predictions are used to determine which station from which of the three complexes: Canberra, Goldstone and Madrid, can be used to communicate with a particular space vehicle. Predictions use available ephemeris for interplanetary as well as “near-earth” objects to determine visibility between objects in space and earth stations. Predictions also take into account planetary and lunar occultation (hiding due to revolution or orbiting) and antenna cable-wrap in providing station availability. All predictions use the center of the earth as the receive/transmit point for all radio communications with space vehicles. Metrics prediction is more complex for near-earth and low-earth-orbit vehicles, so is performed in incremental steps in order to not monopolize system resources needed for other NSS functions. Predictions are made supporting one-way, two-

way and three-way communications with the spacecraft. One-way is station to spacecraft only. Two-way consists of receiving a return transmission at the transmitting station. Three-way entails transmission from one station and reception at a second station. The primary output for Metrics Prediction is a “view period” file for each spacecraft.

1.2 Purpose

The purpose of CWO 16 is to enhance the current system to provide the requirements below:

- R35 - Accept NAVIO/J2000 Ephemeris
- R58 - Galileo Project Support
- R59 - Provide Cable Wrap Data
- R60 - Support TSA Subsystem
- AR13158 - (SCH) Correct for repeated alarms for the same conflict appearing in the scheduling log file.
- AR17600 - (TPAP) Correct for TPAP prompts being inconsistent when adding stored parameter values.
- AR20457 - (TPAP) Correct for termination of processing when effect event has delayed application.

Delay (light-time delay) metrics will be a new capability of this development.

1.3 Goals

In addition to implementing the above functionality, JPL's goals focus on continued DSN modernization, taking full advantage of the latest technology, tools and development processes supporting a concurrent engineering paradigm.

2. SOW & Deliverables

The Statement of Work For CWO 16, Metrics Prediction, is stated verbatim as it appeared with the original request for estimate. Deliverables were not provided with this request, but are documented here as determined through discussions with cognizant personnel.

2.1 SOW

Will be responsible for the continued enhancement and maintenance of the Metric Prediction Software component of the Network Support Controller (NSC), Network Support Subsystem (NSS).

The task will require an individual with software design and programming skills of a very high caliber in the C-language and FORTRAN, an excellent knowledge of applied mathematics, and equally outstanding skills in fault analysis and correction. The task includes development of requirements, program, test, and document software products in support of project mission objectives.

Specific deliverables to be worked out between JPL and ISDS and included in the Work Implementation Plan (WIP).

2.2 Deliverables

In response to the requirements listed above, all CWO deliverables are enumerated below to assure that both JPL and the CWO team know what is to be produced for this CWO.

2.2.1 CWO-Specific Deliverables

All deliverables for CWO 16, as determined by discussions with cognizant personnel, relate directly to modifications and additions to NSS software as follows.

1. Modification to "RECEIVE VALIDATE AND STORE INPUT DATA" supporting

requirement, R35 - Accept NAVI/J2000 Ephemeris

2. Modification to "GENERATE INTERNAL DATA FOR PREDICTION GENERATION" supporting requirements 58 -Galileo Project Support and R60 - Support TSA Subsystem
3. Modification to "PROVIDE INTERNAL DATA FOR PREDICTION GENERATION" supporting requirements R58 - Galileo Project Support and R60 - Support TSA Subsystem
4. Modification to "PROVIDE APPLICATION INTERFACE FILE" supporting requirements R58 - Galileo Project Support and R60 - Support TSA Subsystem
5. Modification to "GENERATE PREDICTIONS" supporting requirements R58 - Galileo Project Support and R60 - Support TSA Subsystem
6. Modification to "GENERATE DISPLAYS" supporting requirements R58 - Galileo Project Support and R60 - Support TSA Subsystem
7. Modification to "GENERATE VIEW PERIODS" supporting requirement R59 - Provide Cable Wrap Data

The above will be modularized and implemented by build. There will be two builds: Build 1 and Build 2. Generally, development required for Galileo support will be provided in Build 1. The remainder of the development is planned for Build 2.

- Delivery dates are as follows:
- Build 1
 - Unit tested Galileo code 4/4/95
 - Build 1 Demonstration 4/28/95
- Build 2

- Unit tested code for non-Galileo-critical functions 7/5/95
- Build 2 demonstration 7/28/95
- Software Integration and Test
 - Pre-acceptance test 9/8/95
- Final SOM 9/17/95
- Final SSD 9/17/95

2.2.2 Deliverables Required by Contract or Derived from the CWO

1. MA005 - CWO Implementation Plan draft, final, and updates as required
 2. MA006 - Monthly Progress Report
- MA007 - CWO Weekly Status and Major Problems Report

SOW MODIFICATION 16-1

1. This SOW is modified as described in this paragraph. Deep Space Spacecraft Simulation requires assistance in requirements analysis and definition. This requires knowledge of the Deep Space Network (DSN) and ability to interface with users and developers in formulating solutions to problems setting the stage for design and development of the NPP subsystem. Knowledge of Object Oriented software development methodology and C++ is helpful. Support to be provided from date of this SOW through 9/17/95. It is anticipated that this support will continue into next fiscal year with associated design and programming effort. This should be taken into consideration when providing this support. This modification also includes trips for two people to the Object World Workshop in San Francisco during the week of August 15, 1995.

3. Software Development Plan

This CWO is continuation of work in progress and follows the plan described in the 11/8/94 Functional Design Review (Level D). This Work Implementation Plan will be modified to reflect changes which occur during the implementation and test phases, through 17 September 1995.

3.1 Technical Approach

This is a one-programmer effort. The technical approach is driven by Galileo. Metrics Prediction is tied directly to the Galileo need for "S-band" support. The Galileo schedule has caused all Galileo-related Metrics Prediction to be in Build 1. Analysis and design documentation reflecting this effort will be provided to technical editors and documentation techs for development of the D-4000 documentation.

3.1.1 Recapitulation of Requirements

No recap. of requirements is necessary at this time past that documented in the "Requirements Summary" provided by the Cognizant Development Engineer at the NSC OP-1 Review.

3.1.2 System Operations Concept

Since this is an expansion of an existing system, the operations concept is well established. Operations concepts will, be reviewed, however, for modifications required due to the new software. Delay metrics will require an application-specific user interface.

3.1.3 Level of Application of the Methodology

Since development is already under way and is in the coding stage, the application of methodology will continue as is. Introduction of CASE tools and formal development processes other than those already in use would cause more problems than they

would solve. Since there is only one programmer, assistance will be offered for as many administrative functions (e.g., from analysis/design to D-4000 standard format) as possible.

3.1.4 Overall Approach

The overall approach is to continue with the current development and with the same programming staff.

3.1.4.1 Requirements Definition and Analysis

Analysis was completed prior to this CWO. Development will be monitored through technical interchange meetings and Software Development Folders to insure requirements are being satisfied.

3.1.4.2 Architectural Design

Design was completed prior to this CWO. Development will be monitored through technical interchange meetings and Software Development Folders to insure design is being implemented. As development progresses, any need for redesign will be assessed and communicated to cognizant personnel.

3.1.4.3 Software Implementation

Software will be implemented in two builds. Defined units will be coded and unit tested to insure implementation is staying on track as defined by the initial requirements.

3.1.4.4 Software Integration and Test

Test plans will be written in adherence to the requirements and the SOM independently of the programming effort. Programming staff time is allocated for their assistance to the independent test team.

3.1.4.5 Installation and Training

There are no special Installation and Training considerations for CWO16.

3.1.4.6 Maintenance and Sustaining Engineering

Post delivery maintenance and user support is anticipated.

The approach for this effort is based on two activities. The first is responding to requests for assistance in a timely manner. The goal of this response is to either resolve the problem or to characterize it in a short period of time. If the problem cannot be resolved, it will be recorded so that resources can be assigned to it consistent with all other priorities of work. The second is examining written (machine readable) records; e.g., outstanding ARs, ISDS problems, and requested changes to first decide the contents of the next

3.2 Integration & Build Approach

This section describes the overall approach for integrating software components into releases, testing release functionality, and demonstrating operability to JPL through acceptance testing.

3.2.1 Responsibility

Jerry Hill, the CWO manager, is responsible for planning and coordinating overall testing and integration activities. However, most of the details will be left to the cognizant programmer, Jonathan Walther. He will be provided with administrative support in preparing for the pre-acceptance test and in providing his input to the SOM and SSD.

3.2.2 Integration & Test Activities

Integration will occur when the build-specific software has been successfully unit tested and placed under configuration management. The cognizant programmer will assist the test team in integrating and testing the Metric Prediction software.

3.2.2.1 Integration Approach

TBD

3.2.2.2 Test Approach

TBD

3.2.2.2.1 Scenarios

TBD

3.2.2.2.2 Preacceptance Testing

TBD

3.2.2.2.3 Acceptance Criteria

TBD

3.3 Resources Required

GFE/GFI resources are described in Section 9

3.3.1 Development Tools & Resources

Development tools are those already in use as this CWO begins.

3.3.2 Integration & Test Resources

In addition to the JPL staff allocated to independent test functions, ISDS will allocate configuration management and administrative assistance to the cognizant programmer in preparing for and providing integration and test support.

3.3.3 Support Resources

Support staff consists of 5 people including the CWO Manager. They will support the cognizant programmer in providing all deliverables.

3.3.4 Cost and Schedule Planning

CWO 16 is currently costed at 1500 hours of cognizant programmer time plus approximately 250 hours for managerial, CM and administrative support.

3.3.5 Project Management Tools

ISDS uses MS Project, Excel, and Word to provide project management support.

3.4 Product Assurance Plan

It is ISDS policy to combine Process Assurance as the combination of Configuration Management, (CM) Quality Assurance (QA), and Process Management into Process Assurance. Each of the subactivities is intrinsically tied to and dependent on the others for success.

3.4.1.1 Introduction

The CM plan for this CWO is derived from and consistent with the ISDS Project CM Plan. This section is laid out in accordance with CSC SSDM Standard 6107.

3.4.1.2 Organization & Responsibilities

The ISDS Product Assurance Officer (PAO), is the configuration management officer (CMO). The PAO reports to management independent of the Program Manager and CWOs. The CMO performs configuration management and data activities as outlined in this CM Plan.

The Configuration Control Board (CCB) for this CWO consists of the CWO Task Manager, the ISDS Program Manager and the JPL CWO Manager, at a minimum..

3.4.1.3 Configuration Identification**3.4.1.3.1 CI Definition**

See Table 3.4.1.3.1-1

Table 3.4.1.3.1-1 CWO Configuration Items

Title or Description	Versions	Notes
----------------------	----------	-------

CWO Implementation Plan	Draft, Revised, Final	Refer to ISDS CDRL MA 005; includes plans for Software Development, Development Review, Software QA, CM, Integration and Test, Software Progress Metrics, Staffing & Profile, and Cost & Schedule, at a <u>minimum</u>
CWO Weekly Status and Major Problem Report	One/Week	Administrative data including updates to CWO status and schedule
Requirements Documentation	Draft and Final	Includes software, hardware and interface requirements documents and specifications which define the Allocated Baseline
Design Documentation	Preliminary, Detailed, Final	Includes design specifications which define the Development and Product Baselines
Source code/libraries	Internally Configured, Baselined	Source code following peer review approval and QA inspection/certification controlled by 'gatekeeper'; updated for Product Baseline
Executables	Internally Configured, Baselined	Object representation of source code following peer review approval and QA inspection/certification controlled by 'gatekeeper'; updated for Product Baseline
Build Procedures	Draft, Final	Procedures defining software release approach
Test Plans/Procedures and Reports	Draft, Final	Includes test data for CIs, the system, acceptance, and operation
Requirements Traceability (Matrix)	Initial, Design Update, Test Update	Matrix traces requirements from system to CIs (Initial), to design documentation, then to test documentation
Training Materials	Draft, Final	Generated following completion of Operational Baseline
User Documentation	Draft, Final	Generated as part of Product Baseline
Operational Baseline/Version Deliverables	Baselined, Updates	Consists of documentation updates to the Functional, Allocated and Product Baselines, and approved acceptance and operational test documentation
Discrepancy/Change Request Forms/Modifications and Repairs	As Required	This includes ECRs, SCNs, DWRs, ECOs and System Problem Reports (SPRs)

3.4.1.3.2 Baselines

Baselines are identified in the previous table. ISDS may choose to internally baseline software or documents even when there is no formal delivery to a JPL organization; e.g., SPMC. We do this to control change to volatile or risky areas of CWOs.

3.4.1.4 **Configuration Control**

3.4.1.4.1 Change Classification

ISDS is compatible with JPL change classification except in two areas:

1. We may classify changes for internal baselines differently than JPL would classify the changes.
2. We typically differentiate between problem fixes (e.g., ARs) and changes of enhancements.

3.4.1.4.2 Change Control Procedures

Change control for this CWO is fully compliant with the change control procedures in the ISDS CM Plan. Mention must be made of several key points:

1. A problem fix, once authorized, is its own authorizing document.

2. An enhancement or change to a baseline typically undergoes a multi-step (and incremental) approval process.
 - Approval to generate the specification and estimate for the change
 - Approval to implement the change based on an approved specification and estimate.
3. A detailed estimate includes all code units and whether they are new, modified, adapted, or converted; all document sections; all training materials; all test scenarios; and all tools.

3.4.1.4.3 Change Implementation and Verification

TBD

3.4.1.4.4 Software Library Control

Formal software control of deployed software is through SPMC. Internal software is controlled by having a separate account on the development machine running SCCS.

3.4.1.4.5 Software Support Environment Control

N/A

3.4.1.5 Configuration Status Accounting

TBD

3.4.1.6 Configuration Audits

TBD

3.4.1.7 Data Management

TBD

3.4.1.8 Configuration Management Tools

- **TBD**

3.4.1.9 Records Collection and Retention

TBD

3.4.2 Software Quality Assurance Plan

The QA Plan for this CWO is derived from and consistent with the ISDS Program QA Plan.

3.4.2.1 Scope

All delivered products are subjected to QA.

All products and tools used to generate internal baselines are subject to QA.

3.4.2.2 Evaluation of Products

All software units, documentation, tests are subjected to multi-stage, in process review.

3.4.2.3 Verification of Processes

Periodically, the CWO manager and PAO will check CWO adherence to established processes and 'best practices'.

3.4.2.4 Course Correction

QA is responsible for determining when problems are not being resolved to the customers satisfaction and reporting this to the CWO manager and program manager.

3.4.2.5 Productivity and Quality Goals

TBD

3.4.3 Review Plan

3.4.3.1 Timing and Location of the Reviews

Formal reviews will be held at the IDI ISDS facility or at the JPL facility.

3.4.3.2 Notification, Agenda and Attendees

The CWO manager, Larry Babb, will be responsible for notifying JPL in advance of a proposed internal review and providing an agenda and list of proposed attendees.

3.4.3.3 Minutes and Action Items

The PAO is responsible for keeping minutes and action items, for posting them in

the CWO database, and for routing them to the responsible parties. The responsible parties will return the proposed resolution to Jerry Hill for review and approval.

Jerry Hill will provide a draft set of minutes and action items within one week of the review and will continue to report the status of action items on a weekly basis to the CWO 16 Task Manager until all action items have been resolved.

3.4.4 Documents

3.4.4.1 Installation & Training Plans - not req'd - See 3.1.4.5

3.4.4.2 Maintenance and Sustaining Engineering Plan - not req'd - See 3.1.4.6

4. Management Approach

The management approach for this CWO is derived from and is consistent with the ISDS Program Management Plan. CWO specific items are limited to the WBS and the details of the CWO.

4.1 Subcontractors

- **Computer Sciences Corp (CSC):** Infotec Development Incorporated (IDI) and Computer Sciences Corporation (CSC) have formed a 'virtual corporation' to execute the ISDS contract. This 'virtual corporation' means there are common processes, comingled staff, and transparent parent-company identity for ISDS staff.
- **Affiliates/Consultants -- Working with JPL,** affiliates and consultants will be called upon as necessary to fulfill JPL requirements.

4.2 CWO Change Management

Change management for this CWO follows the process defined in the ISDS Program Management Plan and in the contract. Should changes be required, they would be documented in this section.

4.2.1 Directed Changes

None at this time.

4.2.2 Claims for Adjustment

None at this time.

4.2.3 Anticipated Changes

Our expectation is that changes are currently limited to schedule changes, priority adjustment, and changing of build contents and that all of these are nominally within the scope of work and estimate for CWO 16.

4.3 Tracking the Work

The ISDS team's approach to measure software development effort is based on "earned value". "Earned value" for this CWO is discussed in detail in subsequent subsections.

4.3.1 Technical Performance Measurement

TBD

4.3.2 Earned Value Measurement Methods

TBD

4.3.3 Cost and Schedule Performance

4.4 Refine Estimates

Estimates are refined in two ways. First, earned value techniques allow us to reflect experience (good experience or bad experience) from one task phase into a subsequent phase. Second, cost and schedule estimation becomes an agenda item at each

major review in order to make the estimates and their assumptions visible to both JPL and ISDS team, a “no surprises” approach to CWO management.

4.5 Software Progress Metrics Plan

The software progress metrics plan to Manage the CWO and to improve our processes is that describe in the project metrics plan with the following exceptions: **TBD**

----- Section Break

5. Risk Management Plan

No risks are perceived for the Metrics Prediction software development, barring an influx of new requirements. The requirements are well known and they are being implemented in a nominally stable NSS development environment. All CWOs are monitored for unexpected developments.

6. Work Breakdown Structure (WBS)

The WBS for CWO 16 is shown below:

ISDS	WBS Description of Work
11	CWO management, planning, reporting, estimating
31	Continued enhancement and maintenance of the Metric Prediction Software component of the Network Support Controller
312	Software analysis and design when applicable
313	Implementation, unit test, developer integration & draft user

doc't

5 System test support

7. CWO Organization and Staffing

This section of the CWO Implementation Plan shows our staff and schedule estimates and describes the processes used to create and refine them. Figure xxx shows the CWO implementation schedule against the WBS.

7.1 CWO Staff Names, Qualifications, & Availability

Jonathan Walther is the cognizant programmer for this CWO. He has extensive experience in metrics prediction and the NSS environment. He is assigned full time to CWO 16.

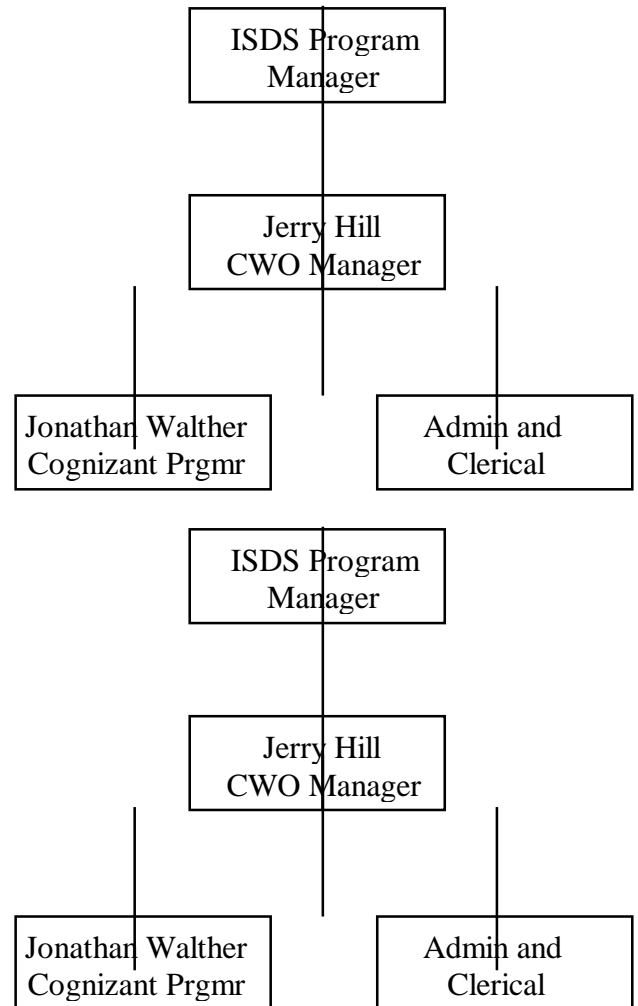
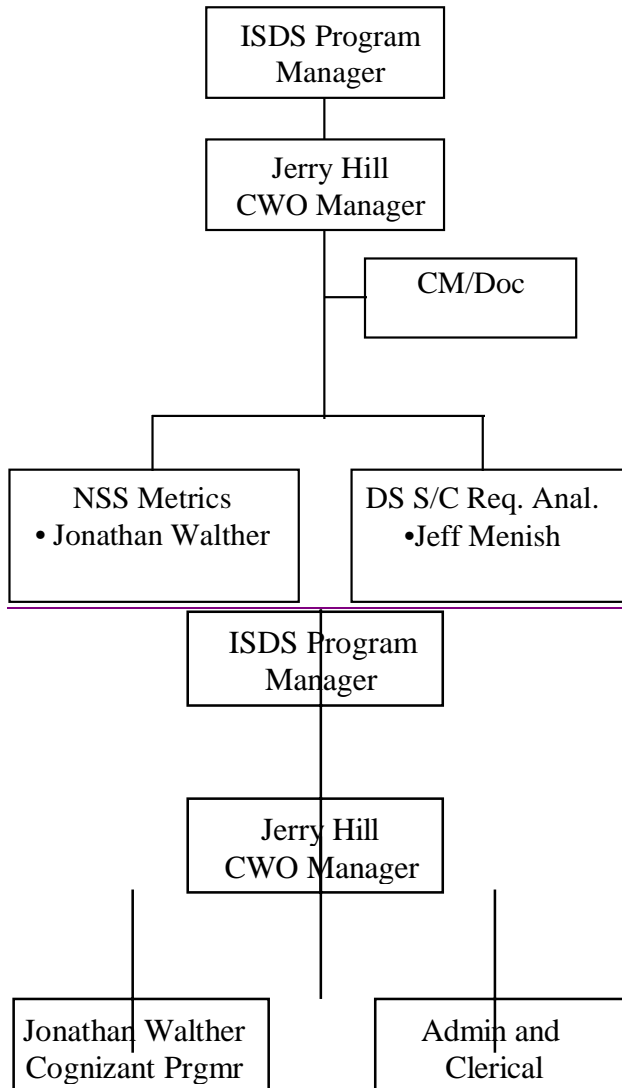
A mix of ISDS staff will provide clerical and administrative support, if needed.

Jerry Hill is the ISDS CWO Manager and author of this WIP.

7.2 CWO Organization

Figure 6.2.1 shows the CWO task organization.

7.2.1 CWO in the ISDS Project Organization



7.2.2 CWO in the JPL Organization

CWO 16 reports to Mr. S. M. (Mike) deGurky, the Group supervisor.

7.3 Staffing Profile

CWO 16 has a flat staffing profile over the duration of the CWO.

7.4 Estimation Approach

Each of the work segments is estimated based on data drawn from within the NSS environment and from the experience of the cognizant programmer persons with Domain knowledge.

7.4.1 Size Estimation

Size estimation is based on identifying all units (e.g., subroutines, functions, packages, interface descriptions, test scenarios, tools) which have to be created or altered (e.g., a little or a lot). Unit counts are converted into Delivered Source Instructions (DSIs) and applied to a COCOMO based estimating model.

7.4.2 Underlying Assumptions for the Sizing Estimate

The CWO 16 sizing estimate is based upon the current stated requirements as presented in the NSC OP-1 review.

Section 5, Risk Management, describes the effects on the estimates should these assumptions not hold..

7.4.3 Overall Staff Profile and Schedule

TBD - This will be a MS Project file appended to this plan.

7.4.4 Maintenance (Sustaining Engineering) Effort

There is a maintenance effort between deliveries and after the final delivery.

There will be between xK and yK lines of code to maintain at each delivery. Using a (JPL defensible) number of **TBD** Source Lines of Code (SLOC) per staff year and not having a significant requirement change, between nn and mm staff years per year are required for ongoing maintenance.

We can expect this level between the first and second deliveries and after the second delivery.

7.4.5 Smooth the Schedule and Staff Profile

We have a **flat staffing** profile.

7.4.6 Apply the Staffing to the WBS

Refer to section 6 for the WBS.

8. CWO Schedule and Dependencies

8.1 Schedule

The schedule for this CWO is linked to the build schedule for NSC OP-1. Build 1 is due the end of April 1995 and contains 2 new and 22 modified Files, including 1 new and 5 modified Fortran programs and associated data and include files. All CWO 16 development required to support Galileo is in this build. Build 2 contains

8.2 Dependencies

Dependencies are those items outside the control of the CWO manager. We identify them here so we can plan for and manage them. Critical dependencies, if any, are included in the Risk Management Plan. There are only a few dependencies on this CWO. They are:

- Mission constraints: Galileo support schedule must be met. Risk has all but been eliminated by placing all Galileo development in Build 1 (Pre-May, 1995)
- JPL facilities: Cognizant programmer tele-commutes. This requires network access to the development Vax.
- JPL support: **TBD**. Documentation and CM support is currently being provided by JPL. ISDS has the capability to provide documentation and CM support.
- User availability: Users will be required for training and demonstrations.
- Site personnel: **TBD**
- GFE/GFI: Network access to Kelvin node, and development Vax and associated equipment.

----- Section Break

9. GFE/GFI Items

There are currently no GFE/GFI items required for this support other than those mentioned above.

10. Close-out Plan

This section will be provided within 30 days from the end of this CWO.

11. Deviations, Waivers, & Exceptions

This section of the CWO Implementation Plan will contain only deviations known at the time of the plan. The list and details of the deviations and exceptions and their waiver status is maintained in the problems data base and reflected in applicable CWO documents (e.g., Software Specification) as applicable.

This CWO has no deviations to established standards and procedures.

12. Appendices

The appendices contain the process descriptions and data dictionary entries for items that appear on System Models, Data Flow Diagrams, and Structure Charts. They are organized alphabetically to make them easy to find and are presented in “structured English” to simplify communication. If CASE tools are used these Appendices provide reference to the machine readable files. Since this CWO is part of a larger project, this documentation is provided by that project (NSC OP-1).

12.1 Process Descriptions

This contains the analysis, typically the structured analysis.

----- Section Break

12.2 Module Specifications

This section contains the design and module descriptions

----- Section Break

12.3 Data Dictionary

The Data Dictionary Entries (DDEs) define the content of the data used by the CWO. The DDEs presented below are a superset of the definitions, data flows and data couples that appear on the models, Data Flow Diagrams, screen definitions, and Structure Charts included in section 1.4 of the CWO Implementation Plan.

If no CASE tool was used, then

The text within this data dictionary is a variant of Backus-Naur Form (BNF). The entries are arranged alphabetically without regard to case, the same way an English dictionary is arranged. Some definitions are English text and some use the following notational conventions:

$::=$ is read as "is defined as"

$+$ is "and". $a+b$ means both a and b

$|$ means "exclusive or". $a|b$ means either a or b , but not both

$[]$ means optional

$m[]n$ means at least m but no more n of them are required. Using n instead of a number for the maximum means an undefined number of repetitions are permitted.

$[]n$ means optional but there can be more than one.

$()$ Parentheses are used to clarify grouping